REMARKS

Claims 1-26 are all the claims pending in the application.

I. Response to Rejections under 35 U.S.C. § 103(a)

a. Claims 1-12, 15-23 and 26 have been rejected under 35 U.S.C. §103(a) as allegedly obvious over Japanese Patent Document No. 05-295087 to Kunihiro et al. ("JP '087") in view of U.S. Patent No. 4,778,851 to Henton et al. and further in view of U.S. Patent No. 6,111,015 to Eldin et al.

b. Claims 13, 14, 24 and 25 have been rejected under 35 U.S.C. § 103(a) as allegedly obvious over JP '087, U.S. Application Publication No. 2007/0122742 to Kato et al., Henton et al. and Eldin et al., and further in view of Japanese Patent Document No. 63-179323 to Nobumasa et al. ("JP '323").

Applicants respectfully traverse the rejections for the following reasons.

Independent claim 1 recites a liquid crystal sealing agent composition that is a one-component resin composition and is light-curable and heat-curable at a curing temperature, comprising:

(1) a solid epoxy resin having a softening temperature by the ring and ball method of 40°C or above;

(2) an acrylate monomer and/or a methacrylate monomer, or an oligomer thereof;

(3) a thermoplastic polymer having a softening temperature by the ring and ball method of 50 to 120°C and lower than the curing temperature, the thermoplastic polymer being obtained by copolymerizing an acrylate monomer and/or a methacrylate monomer with a monomer copolymerizable therewith;

(4) a light-activated radical polymerization initiator; and

(5) a latent epoxy curing agent.

JP '087 discloses a liquid crystal sealing agent that is a one-component light and heat-curable resin comprising:

(a) a partial acrylized or a partial methacrylized epoxy resin;

(b) an acrylate or a methacrylate, or an oligomer thereof;

(c) a solid epoxy resin with a softening point above 40°C;

(d) a light-activated radical polymerization initiator; and

(e) a latent epoxy curing agent.

As the Office Action concedes, JP '087 fails to disclose a composition including a thermoplastic polymer having a softening temperature by the ring and ball method of 50 to 120°C and lower than the curing temperature, which is obtained by copolymerizing an acrylate monomer and/or a methacrylate monomer with a monomer copolymerizable therewith, as recited in present claim 1.

Henton et al. discloses toughening a wide variety of epoxy resins by adding thermoplastic grafted rubber particles having a core-shell structure, wherein the grafted rubber particles comprise an acrylate core and an ethyl acrylate/methacrylic acid copolymer shell in a preferred embodiment.

The object of adding thermoplastic grafted rubber particles in Henton et al. is to toughen a wide variety of epoxy resins. By using reactive grafted rubber particles having an epoxy resin-insoluble core (claim 1), toughness of the cured products has been improved without deteriorating heat-resisting properties (column 6, lines 51-56).

Henton et al. does not provide sufficient motivation to apply thermoplastic grafted rubber particles having a softening temperature by the ring and ball method of 50 to 120°C and lower than the curing temperature to a liquid crystal sealing agent, such as that described in JP '087.

Eldin et al. discloses that rubber toughgeners may be solid or liquid in an initial state (column 3, lines 26-27). However, Eldin et al. relates to the toughness of cured products and

does not provide sufficient motivation for employing a rubber toughener in a liquid crystal sealing agent.

In the present application, a thermoplastic polymer having a softening temperature of 50 to 120°C and lower than the curing temperature is employed to be molten and compatibilize, e.g., (1) a solid epoxy resin with (2) an acrylate monomer and/or a methacrylate monomer, or oligomer thereof, and to swell the compatibilized thermoplastic polymer to prevent viscosity decrease of the liquid sealing agent composition before curing, and to prevent the constituents of the liquid crystal sealing agent composition from exuding and diffusing into the liquid crystal (page 18, lines 4-14 of the present specification).

Applicants submit herewith a further Declaration under 37 C.F.R. § 1.132 by Mr. Yasushi Mizuta, a co-inventor of the present invention. The Declaration demonstrates unexpected results achievable in the presently claimed composition and thus further supports the patentability of the present claims.

Specifically, in the Declaration, thermoplastic polymers having softening temperatures of 52°C, 65°C, 97°C and 113°C were prepared (Synthesis Examples 7-10). Liquid crystal sealing agent composition Examples 6 to 9 containing the thus prepared thermoplastic polymers were prepared in the same manner as described in Example 1 of the present specification. Examples 6 to 9 were evaluated in the same manner as described in Example 1 of the present specification. The results are reproduced in following Table 2 along with Examples 1-5 and Comparative Examples 1-4 contained in a Declaration previously filed on April 7, 2008:

Table 2

Test results of liquid crystal sealing agent composition

Test item	EX. 1	EX. 2	EX. 3	EX. 4	EX. 5	EX. 6	EX. 7	EX. 8	EX. 9	Comp EX. 1	Comp EX. 2	Comp EX. 3	Comp EX. 4
Liquid crystal sealing agent composition	P1	P2	P3	P4	P5	P6	P7	P8	P9	C1	C2	C3	C4
Viscosity stability	A	A	A	A	A	A	A	A	A	A	A	C	A
Glass transition temperature of light cured product (℃)	86	88	86	83	89	81	84	89	90	55	59	—	92
Gel fraction of heat cured product (%)	82	88	86	83	84	80	83	87	89	78	55	—	91
Cell gap size stability test	A	A	A	A	A	A	A	A	A	B	B	—	A
Bonding strength after light curing (MPa)	5.1	3.1	4.0	4.2	4.9	5.4	5.0	4.7	4.2	4.8	0.1	—	3.2
Bonding strength after light and heat curing (MPa)	20.2	17.5	19.0	17.8	19.0	17.2	18.4	21.0	18.3	16.0	1.2	—	15.0
Display characteristics test of liquid crystal display panel	A	A	A	A	A	A	A	A	A	B	C	—	A
Display characteristics test of shaded area of liquid crystal display panel	A	A	A	A	A	A	A	A	A	B	C	—	B

As shown in above Table 2, Examples 1 to 9, which contained a thermoplastic polymer having a softening temperature of 52°C, 65°C, 80°C, 97°C, 105°C and 113°C, respectively, exhibited superior results to Comparative Example 2 containing no thermoplastic polymer, in terms of glass transition temperature of light cured product, gel fraction of heat cured product, cell gap size stability test, bonding strength after light curing, bonding strength after light and heat curing, display characteristic test of liquid crystal display panel, and display characteristics test of shaded area of liquid crystal display panel. In addition, Examples 1 to 9 exhibited superior results to Comparative Example 3 containing a thermoplastic polymer having softening temperatures of 40°C at least in terms of viscosity stability. Furthermore, Examples 1 to 9

exhibited superior results to Comparative Example 4 containing a thermoplastic polymer having softening temperatures of 122°C in terms of bonding strength after light curing, bonding strength after light and heat curing, and display characteristics test of shaded area of liquid crystal display panel.

These data clearly show that the compositions containing thermoplastic polymers having a softening point of 50 to 120°C and lower than the curing temperature as defined in present claim 1 result in superior physical properties to those compositions containing thermoplastic polymers outside the recited range, thereby establishing the criticality of a thermoplastic polymer having a softening point of 50 to 120°C and lower than the curing temperature to a liquid crystal sealing agent composition.

None of JP '087, Henton et al. and Eldin et al. teach or suggest these superior results obtainable with the liquid crystal sealing agent composition as recited in present claim 1.

Kato et al. is relied upon as merely disclosing the softening point for EOCN-1025. Further, JP '323 merely discloses a method for preparing a liquid crystal display element without allowing air bubbles to remain in the liquid crystal by dropping a required amount of weighed liquid crystal on the inside of the sealing agent and thereafter curing the sealing agent. Neither Kato et al. nor JP '323 rectify the deficiencies of JP '087 in view of Henton et al. and Eldin et al.

In view of the foregoing, Applicants respectfully submit that claim 1 is patentable over JP '807 in view of Henton et al. and Eldin et al., and further in view of Kato et al. and JP '323, and thus the rejections should be withdrawn. Additionally, claims 2-26 depend from claim 1, directly or indirectly, and thus are patentable over the cited references at least by virtue of their dependency.

II. Conclusion

From the foregoing, further and favorable action in the form of a Notice of Allowance is believed to be next in order and such action is earnestly solicited. If there are any questions concerning this paper or the application in general, the Examiner is invited to telephone the undersigned at his earliest convenience.

Respectfully submitted,

BUCHANAN INGERSOLL & ROONEY PC

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